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アメリカ銃社会のジレンマ
—50州パネル・データによるブレイディ法とシャル・イシュー法の政策評価—

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Dilemma in American Gun Society
—Quantitative Analyses of Brady and Shall-Issue Laws with Fifty-State Panel Data—

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要　約

2007年4月16日ヴァージニア工科大学において一人の学生の銃の乱射により32名の学生・教師が生命を失った。現在2億丁を超える銃を抱え毎年400万丁以上の銃が増え続けるアメリカ社会において、銃規制また銃の保有と携行に関する各種の政策の評価が多くの研究者により行なわれている。1990年代のアメリカ社会における銃による死傷者の数は劇的に減少をしたが、このことを予測した研究論文の発表はなかったことが指摘されている。ロットとマスタードは、この原因を1986年以来、各州がシャル・イシュー法を採用し、銃の携行を願い出た一般市民にほぼ一律に許可を与える州が増大したからであると1997年の論文において結論付けた。これに対し、クックとルートウィックは、銃による死亡事件の社会費用は、関連する諸費用をすべて含めれば一件当たり100万ドルを超えるとし、銃規制の重要性を訴えると共に、ルートウィックは、90年代の銃による死傷者の減少はシャル・イシュー法とは統計的に有意な関係は認められない、と反論を試みた。銃による殺人と死傷者の件数の劇的減少が、はたして銃規制派の議会への運動により実施されるに至ったブレイディ法とその後継法か、それともシャル・イシュー法にあるのか、アメリカ銃規制問題の焦点の一つとして現在も論争が続けられている。本稿においては、1976年から2004年の28年間の全米50州にワシントン特別行政区を加えたパネル・データを構築し、ブレイディ法とシャル・イシュー法を政策変数化することで、数量分析を行ない、ブレイディ法と1999年以降のその後継法である全国即時背景システム(National Instant Check System)が統計的に有意な影響を与えていることを論証した。

Introduction

On April 16, 2007, thirty-two people were shot to death by a student of Virginia Tech. It is called the Virginia Tech massacre, the worst single shooting incidence through U.S. history, and occurred only eight years after the Columbine High school massacre, in which twelve students and teachers were killed by two high school

students. It is said that more than 220 million handguns exist now in the U.S. and that 4 million of rifles, shotguns, and handguns are being produced each year (Cook and Ludwig 2000).

The Second Amendment of the U.S. Constitution reads "A well-regulated militia, being necessary to the security of a free State, the right of the people to keep and bear arms, shall not be infringed." The interpretation of the Second Amendment has long been discussed. Anti-gun control groups have advocated that the amendment guaranteed the individuals rights to keep and bear arms. However, militia has been replaced by the National Guards since the late 19th century, and there were only four cases brought into the Supreme Court, regarding more or less with the interpretation of the Second Amendment. The last case was the U.S. vs. Miller et al in 1939: the Supreme Court remanded the case to the district court while the two defendants were killed or made a plea bargain later, so the case was never completely reviewed. It is curiously important that the case was upheld by both gun-control and anti-gun-control groups, claiming tax could be imposed on a short-barreled shotgun as a specific military weapon. For gun-control groups, federal tax would be a gun-control measure whereas for anti-gun-control groups, a military weapon could be possessed by civilians under state tax. Even putting aside the issue of the U.S. vs. Miller et al in 1939, the sense of group self-preservation of self-defense is strong in the U.S. through its history and weapons were the natural backbone of the wilderness civilization (Hays 1960).

The Bureau of Justice Statistics record of the ratio of homicide and overall gun-related crimes per 100,000 from 1976 to 2004 dramatically decreased during the 1990's as **Figure 1** shows. **Figure 1** indicates two kinds of data: one is the overall number of gun crimes and the other is overall number of homicide with guns, both adjusted in the population of 100,000 nationally. The reason why two figures are combined into one is show that the peak appears in the same year of 1994 and that thereafter both ratios decreased drastically.

The drastic decrease began in 1994 to last through 1990's, and the gun homicide rate is rising slightly only since 2000. The ratio of gun-use in homicide varies in years and among states, but it was 63.98 percent from 1976 to 2004 with data given by FBI Uniform Crime Data.[(1)]

No researchers predicted this drastic change of homicide casualties before 1990 (Levitt 2004). Researchers analyze factors to explain why gun-crime rate began declining in 1994 and lasted during the 1990's. Lott and Mustard maintain the deterrence effect of carrying concealed weapons, CCW,[(2)] has affected the decreasing number of gun-related crimes and homicide rate after 1994 (Lott and Mustard 1997; Lott 2000). The number of those states has increased up to be thirty-six as of 2004

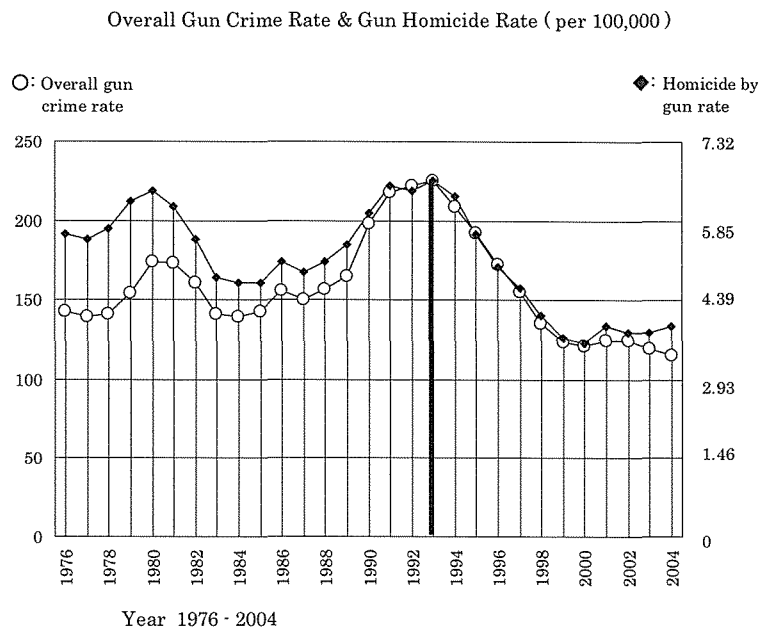

Figure 1 Peak in 1993 in Gun-related Crime Rate
Source : FBI Uniform Crime Report, January

from the only one state of Vermont before 1986.[3] Those states allow citizens to carry concealed weapons when they meet the requirements: the permission "shall issue" to all the applicants without discretion if they pass the test of felony history, age, and mental disorder.[4] Before 1986, only the state of Vermont allowed its citizens to hold the right to carry concealed weapons state-widely, but in 1986, eight new states passed the "shall-issue" law, which Lott and Mustard describe as the year of beginning of "shall-issue" deterrence (Lott and Mustard 1997). The deterrence effect of carrying concealed handguns have been supported by other researchers, using quantitative and qualitative methodologies (Kleck 1999; Kleck and Jongyeon 2004).

On the other hand, Cook and Ludwig present social cost of handguns and carrying them in public (Cook and Ludwig 2000, 2006). They maintain that the substantial costs of gun violence to society exceeds around $1 million per injury caused by guns (Cook and Ludwig 2000).[5] Gun crimes account for around 80% of the $100 billion in social costs that gun violence imposes on American society each year (Cook and Ludwig 2006). From the view of public health, gun-related incidences cause enormous negative effects on not only family, but also society at large. Bereaved families suffer from lack of their beloved ones financially and psychologically. Urgent medical care and thereafter rehabilitation cost the injured by gun as well as those firms they work for, deteriorating general conditions of working environments in society. To combat such

gun-related cost and tragedies, the Federal Government has been engaged in Project Safe Neighborhoods, PSN,[6] in which gun locks, child-proof devices, and other measures should reduce gun incidences.[7] However, Ludwig emphasizes that PSN's budget has been expended more on punishment, resulting in less effectiveness on street-level law-enforcement: i.e., gun carrying or use in crime on streets (Ludwig 2005).

In this thesis, the panel data consisted of fifty states plus Washington DC, hereafter fifty-state panel data, are constructed, mainly using FBI Uniform Crime Report, Bureau of Economic Analysis, U.S. Census Bureau, Department of Labor.[8] It is fundamentally important and necessary to assess the effectiveness of policy by Federal, State, and municipal governments. Social science researchers have improved the methodology to measure the level of policy effectiveness. This thesis adopts Treatment Dummy Variable, TDV,[9] to assess Brady Handgun Violence Prevention Act of 1993, so called "Brady Act," and "shall issue" law or CCW law in three kinds of analytic models in the panel data: a Difference-in-Difference, DID, regression model, Least-Squared Treatment Variable, LSTV, model, and Fixed-effect and Random-effect models. The models show that "shall-issue" law has not directly contributed to the curtailment of homicide rates by gun, but gun-control measures effectively relates to the diminishment of gun-homicide and overall gun-related cases.[10]

Methodology

Ratio Variable to Measure Policy Effectiveness

In general, measuring policy is difficult to work out. When a certain law or direction is given in society, how much the law precisely exerts the effects is an arduous task. A story tells that a young woman with her child faced carjack, and when she showed her handgun from through the window, a carjacker gave up and left (Lott 2000). This story allegedly persuades the public to acknowledge how carrying concealed handgun or CCW holds deterrence effect against criminals. On the other hand, a mentally unstable woman purchased a handgun in a state where no waiting period is imposed, and walked into a hospital to shoot a complete stranger to her (Bradycampaign.org 2006). This tragedy compels the public to be aware of the significance of waiting period and more strict regulation to purchase handguns. To investigate and research individual cases is critical.[11] In this thesis, the public policies of gun-control and CCW are evaluated with quantitative methodology of fifty-state panel data set to assess which policy is more effective in reducing gun-homicide cases, deterrence-by-gun policy or gun-control policy. Qualitative researches in individual cases hold different analytical frameworks than quantitative ones, and two methodologies should collaborate to examine the issues in social and human sciences.[12]

Policy implementation such as Brady Act and CCW is measured by dummy variable.[13] The waiting period is a policy in which Brady law imposed five days to all the states, and after its expiration each state discretionally has imposed by its own state provision since 1999.[14] If one wants to estimate the relation between waiting period and gun-related homicide, it is highly common to use the number of days in waiting period to compare the homicide rates among fifty states.

After Brady law expired in December 1998, it could be divided into two directions: one is "waiting period" by state and the other National Instant Check System, NICS.[15] "Waiting period" is depends on each state: there are only eighteen states, which impose "waiting period" after the expiration of Brady law in December 1998.[16] For instance, California sets its waiting period for 10 days while New York requires the 180-day waiting period. Michigan required only one day for waiting period and Oklahoma imposed no waiting period. The waiting period of each state is shown in Supplement Data 1.

Introducing TDV to Measure Policy as Treatment

The fifty-state panel data could be used to analyze how each state holds different effect to gun-related homicide rate as well as how the policy variables affect its ratio. In analysis, treatment variable, TV, exerts a significant role: it is consisted of "1" if a state adopted a law and "0" otherwise. TV holds good rationality to evaluate the relations between policy and its effectiveness. TV holds not only steady methodological handling, but also the benefit of improving VIF values in general. VIF stands for Variance Inflation Factor and its significance attests to the existence or non-existence of multicolinearity in the model.[17] It is practical to use TV in assessing how Brady law or CCW law is related with gun-homicide ratio, avoiding multicolinearity.[18] The shall-issue law began its trend in 1986. Before 1986, there was only one "shall-issue" state.[19] As of 2004, however, thirty-six states adopted the law as shown in Supplement Data 2.[20] When a state adopted "shall issue" law, "1" is given to the value of CCW to the state in that year and thereafter.[21]

As for gun-control factors, they are divided into two factors: one is Brady Act and the other is NICS, National Instant Check System. Brady Act was implemented on February 18, 1994 nation-widely, and expired on December 30, 1998, as a sun-set law.[22] Since the beginning of 1999, NICS began its background check on all the purchasers through internet or calling. NICS serves only for the background check and the waiting periods were discretionally determined by each state. However, most states changed the waiting period since NICS began at the beginning of 1999. Before 1994, only very few states adopted state-wide waiting period for purchasers: in most states, city- or county-level discretion was effective to impose waiting period or not.[23] Since

1999, however, seventeen states impose state-wide waiting period.[24] Policy Treatment Variable and waiting-day variables are shown in TABLE 1.[25]

TABLE 1 Policy Treatment Variables and Waiting Period Variable

CCW	0	no "shall issue" law	1	"shall issue law"		
Brady	0	before 1994, all	5	1994 - 1998, all	N	1994 - 2004, wp
NICS	0	1976 - 1998, all	1	1999 - 2004, all		

Note: "all" means all states. "wp" denotes waiting period in each state, and "N" is the number of waiting days to purchase handguns in each state. The value of CCW depends on the year when each state adopts "shall issue" law.

Models with Panel Data

Fifty-state panel data are constructed with the year of "shall issue" adoption, waiting period, Gross State Product change per capita, State unemployment rate, and disposable personal income per capita.[26] The regression models are tested in the following Least-Squared-Dummy-Variable model, Difference-in-Difference model and Fixed- and Random-effect models.[27]

Fifty-State Panel Data Model

1) *Least-Squared-Dummy Variable Model*

:

$$Y_t = \beta_0 + \beta_1 CCW_t + \beta_2 Brady_t + \beta_3 NICS_t + \beta_4 log\ (state\ unemployment) + \beta_5 log\ (GSPchange) + \beta_6\ (Disposable\ Income) + \beta_{7\text{-}58}\ (Least\ Squared\ Treatment\ Variables,\ LSTV,\ of\ State_1\ to\ State_{51}{}^{(28)})$$

2) *Difference-in-Difference Model:*

$$Y_t = \beta_0 \times \text{Treatment} + \beta_1\ \text{AfterTreatment} + \beta_2\ \text{Treatment*AfterTreatment}$$

3) *Fixed and Random Effect Model*

$$Y_t = \beta_0 + \beta_1 CCW_t + \beta_2 Brady_t + \beta_3 NICS_t + \beta_4 log\ (state\ unemployment) + \beta_5 log\ (GSPchange) + \beta_6\ (Disposable\ Income) + constant$$

Variable Y_t: *the explained variable*

Yt denotes the number of cases of homicide with gun per 100,000 population in

each state of the year of t from 1976 to 2004: Y_t = Rate of homicide by gun each year per 100,000 (from 1976 to 2004).[29] The aggregate national ratio is shown in Supplement Data C.

Variable CCW_t *and ptv-*CCW_t *: a measurement variable of "shall issue" states*

As of the end of 2006, only Illinois and Wisconsin are NOT "shall issue" states: for the availability of data, especially FBI Uniform Crime report, this thesis analyzes the data as of the end of 2004.

Policy treatment dummy variable holds rather interesting characters. In national data models, TDV holds the good R-squared and adjusted R-squared index and residual normality test such as the Shapiro-Wilk W residual test and the inter-quartile test for outliers.[30] However, if a "trend" variable is included, the value of "trend" causes multicolinearity (VIF test) and autocorrelation (Durbin-Watson test) in the model. Therefore, trend is omitted when economic variables are included.

The problem of endogenous propensities in independent variables can be solved in several ways such as Simultaneous Equation Model,[31] Two-Stage-Least-Squared Model, 2SLS, Instrumental Variable, IV, and others. In this thesis, the problem is dealt by Difference-in-Difference methodology in fifty-state panel data.

Variable $Brady_t$*: a measurement variable of Brady Act*

$Brady_t$ is a variable to show the implementation of Brady Handgun Violence Prevention Act, which includes "waiting period" and "background check." Although forty-one states adopted some waiting period before 1994, there was no "federal" law to mandate "waiting period" uniformly. Before 1994, each state had its discretion, and waiting period was mostly not state-widely, but rather on county-level discretion by sheriffs and police officers.

To measure the value of uniform state-wide waiting period and background check of Brady Act, "0" is assigned from 1976 to 1993, "5" is given from 1994 to 1998. From 1999 to 2004, the values are given in accord with the waiting days imposed by each state as Supplement Data A shows.

Variable $tvNICS_t$ *: a treatment variable to measure background check in NICS*

As discussed above, Brady Act held two different gun-control implementations: federally uniform 5-day waiting period and background check on purchasers.

$$NICS_t = \begin{cases} 0 & t = (1976-1998) \\ 1 & t = (1999-2004) \end{cases}$$

After Brady Act waiting period expired on December 30, 1998, National Instant Check System, NICS, replaced it. NICS is a computerized background check system, and each state has discretion to check the background of purchaser by the data in state or federal.

In 1997, the Supreme Court verified that federal background check is illegal from the view of Tenth Amendment in the case of Printz v. the U.S.[32] Brady Act includes computerization of checking background, so it originally set the expiration date in five years when it was passed in the Congress. Thereafter, National Instant Check System began working on the background check, but the system is said to hold some loophole problems such as fraudulent identification of applicants through the Internet. Therefore, differentiating waiting periods succeeding Brady Act, the effect of NICS is evaluated by a different explanatory variable as a policy treatment variable of ptv-$NICS_t$, in which "0" is assigned from 1976 to 1998 and "1" from 1999 to 2004.

Variable ***Ldpid, Lgsune, Lggspch***: *State economic data*

Lgpid is the logarithmic value of "personal income disposal" in each state. The reason why the logarithmic value is used is to keep linearity in the models, and this apply to *Lgsune* and *Lggspch* as well: Lgsune is the logarithmic value of "state unemployment rate" in each state while *Lggspch* is the logarithmic value of "gross state product changing rate" from the previous year in each state.[33]

These three variables are introduced to show how much gun-homicide are related with aggregated economic conditions. Intuitively, unemployment rate and inflation would positively affect gun-related crimes and Gross State Product change would negatively affect them.

John Lott maintains that unemployment rate positively affect the decrease of gun-related crimes and homicides (Lott 2000), but the models here show that more unemployment results in more gun homicides. It seems that Lott's assessment implies the indirect effects of "shall issue" law with other variables such as unemployment[34], but this issue will be further evaluated in discussion.

Results of Fifty State Panel Data Analysis

The fixed-effect, FE, model and random-effect, RE, model are usually used in panel data analyses. However, R-squared value of FE and RE models are less than .084 within and less than 0.16 between variances to be explained.[35] Therefore, the both models cannot explain enough residual fluctuation, so this thesis does not fully facilitate FE or RE model to analyze the effect of policy on gun-homicide rate.

The index of Gross State Product per capita, Disposable Income per capita , and unemployment rate in each state are obtained from Bureau of Economic Analysis, Department of Commerce.[36]

Table 2 shows the results of Least-Squared-Treatment-Variable Regression Model.[37] The coefficients or slope of each state on the increase of gun-homicide rate is

from 1.27 (South Dakota) to 7.3 (California). As long as considering the ratio, the model holds significance in practical and statistical implication.

Table 2 Least-Squared-Treatment-Variable Regression Model in Fifty-State Panel Data

Lggun	Coef.	t		Iggun	Coef.	t		Lggun	Coef.	t	
CCW	0.0250	0.90		Illinois	6.3314	18.97	*	New York	6.7642	20.30	*
Brady	−0.0024	−3.11	*	Indiana	5.3405	16.73	*	North Carolina	5.7497	17.88	*
NICS	−0.2372	−9.25	*	Iowa	3.0700	9.57	*	North Dakota	1.2798	4.10	*
Lgpdi	0.0360	1.22		Kansas	4.1212	12.76	*	Ohio	5.7229	17.39	*
Lgsune	−0.0451	−1.19		Kentucky	4.9928	15.42	*	Oklahoma	4.7550	14.82	*
Lggspch	−0.0046	−0.33		Louisiana	5.9423	18.26	*	Oregon	3.8944	11.86	*
Alabama	5.4348	16.93	*	Maine	2.2563	7.07	*	Pennsylvania	5.8090	17.79	*
Alaska	3.1095	9.11	*	Maryland	5.4829	16.58	*	Rhode Island	2.6196	7.97	*
Arizona	5.0455	15.47	*	Massachusetts	4.2554	12.89	*	South Carolina	5.1582	16.01	*
Arkansas	4.7465	14.75	*	Michigan	6.1417	18.48	*	South Dakota	1.2732	4.05	*
California	7.3035	21.72	*	Minnesota	3.8102	11.70	*	Tennessee	5.5380	17.02	*
Colorado	4.3838	13.32	*	Mississippi	5.1387	15.91	*	Texas	6.8787	21.02	*
Connecticut	4.1575	12.73	*	Missouri	5.4449	16.91	*	Utah	3.1018	9.73	*
Delaware	2.4741	7.32	*	Montana	2.6963	8.35	*	Vermont	1.6694	5.26	*
DC	4.9310	14.82	*	Nebraska	3.0526	9.65	*	Virginia	5.4982	16.99	*
Florida	6.3154	19.31	*	Nevada	4.1284	12.42	*	Washington	4.5094	13.65	*
Georgia	5.9098	18.35	*	New Hampshire	1.8797	5.87	*	West Virginia	3.9052	12.06	*
Hawaii	2.5776	7.93	*	New Jersey	4.9970	14.90	*	Wisconsin	4.3643	13.41	*
Idaho	2.7134	8.49	*	New Mexico	4.1859	12.79	*	Wyoming	1.9381	6.00	*

*p>.99 Adjusted R-squared 0.9608

Difference-in-Difference Estimator

Using the panel data, Difference-in-Difference estimators are calculated.[38] The difference of the gun-homicide rate is estimated by treated states and control (non-treated) states. DID estimator is equivalent to GLS, generalized least-squared, model estimator: that is, maximum likelihood method is applied to the function of dependant variable.[39]

Table 3 DID Coefficients and t-values of CCW, Brady, and NICS

	Coefficient	T	Adjusted R-squared
CCW	0.3597	2.80*	0.039
Brady_after	−0.5039	−0.37	0.060
NICS	−0.1320	−0.21	0.020

* p>0.99

Although Adjusted R-squared values is small, CCW shows statistically significant coefficient of positive .3597, which implies that the treatment of CCW increases the gun-homicide rate of 0.3597 through the panel data.

The same effects of each policy can be observed FE and RE models although the values of R-squared are small. The structure of models are of the same in regression models with national data[40], but in panel data, the effects of TVD might be more complicated within state and year and between state and year. DID and FE/RE models give another tendency of these three policies, CCW, Brady Act and NICS. **Table 4** shows the results of Fixed and Random effect Models by fifty-state plus Washington D.C. panel data. The coefficients of Brady and NICS negatively affect the gun homicide rate with statistical significance while "shall issue" does not hold statistical significance: it is noteworthy that the sign of coefficient of "shall issue" is positive, which means it positively affect the gun homicide ratio.[41]

Table 4 Fixed- and Random-Effect Model by Fifty-State Panel Data

		FE model	RE model	BE model
R-squared	within	0.0830	0.0831	0.0577
	between	0.1525	0.1680	0.3086
	overall	0.0010	0.0003	0.0139
log(gun homicide rate)				
Coefficient	CCW	0.0250	0.0247	−0.6581
		(0.9)	(−0.88)	(−0.78)
	Brady	−0.0024 **	−0.0023 **	0.0563
		(−3.11)	(−3.06)	(1.46)
	NICS	−0.2372 **	−0.2373 **	−14.1238
		(−9.25)	(−9.21)	(−0.91)
	log(gspch)	−0.0046	−0.0035	1.6816
		(−0.33)	(−0.25)	(1.51)
	log(sune)	−0.0451	−0.0393	3.2704 **
		(−1.19)	(−1.04)	(3.29)

log(pdi)	0.0360	0.0384	0.0568
	(1.22)	(−1.3)	(0.03)
const.	4.3967	4.3329	−1.6693
	(13.72)	(11.58)	(−0.10)
σ (u)	1.5379	1.3555	
σ (e)	0.3035	0.3035	
ρ	0.9625	0.9523	
	(t-value)	(z-value)	(t-value)

** 99 percent significance

Discussion

The trend of homicide by guns has not been controlled by the increase of "shall issue" states in the panel data. Brady Act and its successor public policy of NICS are more effective to reduce the trend. From the view of public policy, "shall issue" states give more permission to carry concealed handguns, but the decreasing trend of gun homicide and gun-using crimes has stopped since 2000.[42]

Brady Act was replaced by NICS, but its implementation of "waiting period" and "background check" should be deployed in each state continuously. Lott explains that even unemployment rate affect negatively the handgun crimes (Lott and Mustard 1997, Lott 2000; Lott 2004). However, the fifty-state panel data model shows unemployment rate plausibly, positively holds an effect on the homicide rate.[43] It is said that the handgun incidences cost more than $100 billion per year (Ludwig 1998; Cook 2000), and to reduce it, gun-control public policy should be implemented continuously. As Webster et al. present that radar-detective scanner is now being developed to search concealed guns in public.[44] In addition, manufacturers' efforts should take responsibility to produce reliable products and child proof and safe devices should be more strengthened.

Lott and Mustard maintain that if all the states adopted "shall issue" law in handgun policy, at least $5.74 billion would be gained in public expenditure (Lott and Mustard 1997). However, Black and Nagin reexamined the data Lott and Mustard used [45] and concluded that Lott and Mustard model is highly sensitive to a small change without Florida cases and that no impact can be found on the decrease of homicide and rape (Black and Nagin 1998).

The debate is followed involving with many researchers. Webster et al. maintain that Lott and Mustard model holds systematic error missing drug markets and/or police practices and that the effect appears in 4 to 7 years later, which mislead the treatment year or point (Webseter et al. 1998).[46] Hemenway also points out the lack

of those variables and criticize their results that both the increasing rate of unemployment and reducing income resulted in the high rate of violent crimes (Hemenway 1998). The reason why drug problems are brought about to criticize Lott and Mustard is that their data covers 1977 to 1992 to show how 10 states, which adopted "shall issue" law in late 1980's, decrease the number of crimes, but crack cocaine are dramatically introduced in 1980's at large and these 10 states had LESS of a crack problem (Donohue 2003). Although Ayres and Donahue praise the data collection efforts by Lott and Mustard, their findings collapse when the more completely county data is subjected to less-constrained jurisdiction-specific specification (Ayres and Donohue 2003a: 1296).

This thesis shows that TDV, treatment dummy variables, are useful to evaluate how much policy affects the explained variable in fifty-state panel data. CCW affects positively on gun-homicide rate while Brady and NICS do negatively effects on it. To discuss the issue more, not only direct effect, but also indirect effect should be considered because the correlation coefficient between CCW and the decrease of gun homicide rate is negative because the "shall issue" states began increasing before 1994 when homicide and crimes rates dramatically decreased.

Negative correlation coefficient, but positive coefficient in regression models means that indirect effect of CCW is quite large: that is, CCW must have high correlation coefficient with other social and economic factors.[47]

So-called deterrence effect must need to be correlated with social, economic, and psychological factors, which can explain why CCW has a negative correlation coefficient and positive coefficient in regression models to gun-homicide ratio. The social, economic, and psychological complexity is required to establish deterrence effect, if possible.

Last but not least, DID analysis in panel data shows significant effects of CCW to gun-homicide rate. This can be interpreted that CCW positively related among fifty states to increase the gun-homicide rate significantly from 1976 to 2004, but Brady Act and NICS do not significantly affect the decrease of it although the sign of both coefficients are negative. In aggregate national data, Brady Act and NICS show significantly negative effect of the increase of gun-homicide rate, but the difference in state shows no significance: that is, state difference holds large factor in gun-control. Some states impose strict "waiting periods" and "background check." In "background check," some state use Federal records, but such records allegedly lack of details comparing with State criminal records. Therefore, DID panel data analysis implies that the difference of state policy in gun-control contribute sufficiently to the ratio of gun-homicide ratio. In this respect, some states which are too lenient on gun-control law

should consider more restrict on gun-control laws.

Endnote

(1) Bureau of Justice Department, Department of Justice, provides FBI Uniform Crime Report on line: http://www.ojp.usdoj.gov/bjs/welcome.html

(2) CCW law denotes the same as "shall issue" law. Gun-control researchers tend to use CCW, and some anti-gun-control researchers are likely to use "shall issue" law. However, both laws means the same provision to issue permission to civilians to carry concealed weapons in the public.

(3) The state of Vermont proclaimed citizens' rights to carry open or concealed weaons without any permission. Alaska also adopted the same policy in 2003: before that, Alaska requires its residents to meet the mandatory to carry concealed weapons.

(4) When citizens have to meet a certain mandatory to carry concealed weapons, it is sometimes called "Florida style" since Florida imposed rather strict mandatory to CCW in 1987. On the other hand, when no mandatory exists in CCW, it is called "Vermont style."

(5) Cook and Ludwig apparently include the cost of medical care and rehabilitation as well as any compensation that the wounded or injured need to be counted in their working places.

(6) Project Neighborhood Safety is provided by Department of Justice in order to make citizens life safer. The project main target is to reduce gun crimes. Structural activities are linked among federal, state, and local law enforcements, prosecutors, and community leaders. 10,841 federal firearms cases were filed in 2005 and 73% were related with PNS. http://www.psn.gov/default.aspx

(7) Due to successful activities by gun lobbies, product liability law is much weaker in handguns, than other products such as vehicle and electric products.

(8) The data are gathering from various resources such as U.S. Census Bureau to consider state population, economic indices from Bureau of Economic Analysis, unemployment rate from Department of Labor. As for the rate of gun-homicide, FBI Uniform Crime Report is essentially facilitated by researchers investigating "shall issue" and gun-control.

(9) Treatment Dummy Variable is also called Policy Dummy Variable since "treatment" in shall issue and gun-control notifies "policy." "Treatment" differentiates samples before and after any change. Therefore, "treatment" notes a broader concept than "policy" in quantitative analyses.

(10) In this thesis, gun-homicide cases per 100,000 are analyzed, but as Figure 1 shows the gun-related crimes per 100,000 actually change almost exactly the same from 1976 to 2004. The results are not shown, but the same statistical results are obtained. The data and its results are available when requested.

(11) Individual cases are quite important in qualitative analyses in social sciences. In gun-control researches as well, media broadcasting gun-related incidences are criticized because media often report when more than two persons are gunned down, not a single person case, excluding a notable citizen.

(12) In either qualitative or quantitative thesis, the researchers usually introduce the results of different methodological results, which lead to multi-facet approaches to the issue. In this sense, qualitative and quantitative methodologies are both considered in researching, not excluding each other.

(13) Dummy variable is consisted of "0" or "1," and often used in quantitative methodology. It could be used to qualitative variable such as categorical data and implementation of policy, so

the name is derived.

(14) The name of CCW law in each state depends on state legal provision: e.g., Code of Alabama 13A-11-75, Alaska Statutes 18.65.700, Arizona Revised Statues 13-3112, California Penal Code 12050, Connecticut General Statues 29-28, Florida Statues 790.06, Official Code of Georgia 16-11-129 and the like.

(15) National Instant Check System, NICS, was introduced when Brady Handgun Violence Prevention Act was expired in December 1998. Brady law was a so-called sun-set law, in which law makers originally set its expiration date in five years when the Congress passed the law.

(16) Because Brady Act was a sun-set law, some documents especially from so-called gun lobies denote that Brady Act was over to regulate gun puchase and background check. These impress the pubic that theer is no gun-regulated public law.

(17) Multicolliniarity is said to occur if VIF value is larger than 10. In the research of gun-control and CCW, various models show VIF values are better in TV than numerical ratio values. Because TV has the value of "0" or "1", it is also called Treatment Dummy Variable.

(18) When Multicolliniarity occurs, R-squared values are irrationally high whereas the model could not explain its dependent variable very well. Therefore, it is essential in regression models to test VIF values.

(19) The state is Vermont, and Vermont was the only state to permit open carry law, in which citizens do not have to conceal weapons. However, open carry law has not been developed enough. As mentioned in Endnote (3), Alaska adopted open carry law. It is said that the following states are considering open carry law as of 2006: Arizona, Idaho, Kentucky, Montana, New Mexico, Ohio, South Dakota, Virginia, West Virginia, and Wyoming

(20) 10 states behold CCW under police jurisdiction (may-issue states, discretionary CCW) Alabama, California, Connecticut, Delaware, Hawaii, Iowa, Maryland, Massachusetts, New Jersey, New York, and Rhode Island. 35 states behold CCW without police jurisdiction: shall-issue states, non-discretionary CCW: Arizona, Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kansas, Kentucky, Louisiana, Maine, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, and Wyoming (*Nebraska and Kansas will be in effect as of Jan. 1, 2007 and to subject to county and municipal restriction). 2 states have No CCW: Illinois, Wisconsin. 2 states require no permission: Vermont and Alaska

(21) The waiting period is complicated because some states require the creation of identification cards for all purchasers when they purchase guns for the first time in the state. Once ID cards are created, some states do not require any waiting periods, but others do. Each value of the waiting period above is given to the Brady variable of each state after 1999.

(22) During those five years, internet-registration system was constructed with the expenditure provided in the provision of Brady Act in 1994. State backgournd check is favorable because the state data of purchasers are more complihensible than that of Federal.

(23) This discretion of authority is called "may issue," which means that the authority "may issue" the permission to a citizen who applied for bearing concealed weapons in the public. It has historical background of segregation policy, therefore, it is said that the discretionary standards were not clear to outsiders.

(24) The problem is the state mandatory sometimes holds exemption such as in Pennsylvania, where its largest city, Philadelphia was excluded in 1989, but later was applied in 1995. In Florida, it took more than two years for all the counties changed the system from "may issue"

to "shall issue." In "may issue" law, the authorities, mainly by police offices, maintain the discretion to issue the permissions to those who apply to carry concealed weapons (see note (9)).

(25) The following states require some kind of safety training before a person can buy a handgun: California, Connecticut, Hawaii, Massachusetts and Michigan. The facts show the difficulty to measure the policy by ratio variables, and treatment variables evaluate policy effectiveness quantitatively.

(26) These economic data is transformed into logarithmic values because of obtaining linearity in the models. Taking logarithmic values quite often occurs in regression models.

(27) Although the FE model and RE model show almost the same coefficients and other numerical values, the models do not fit very well. The reason might be derived from the similarity in the structure of CCW and Brady. CCW began in 1986 and has increased its state through 2004, and Brady Act began in 1994 and has been effective even after its expiration due to federal program such as PNS and state government requirements. NICS treatment periods are only six year in the model among 29-year observational periods, which might be too small to observe the contribution to the fluctuation of homicide ratio in each state.

(28) $State_{51}$ denotes Washington D.C.

(29) Homicide number of each state is first obtained, and the ratio of weapons is multiplied to obtain the real number of homicide by guns. Data is aggregated into national data. Data is all obtained at the following FBI Uniform Crime Report web site: http://www.ojp.usdoj.gov/bjs/

(30) In analyzing the aggregate national data by regression model, treatment variables are better than ratio variables considering the ratio of state population to national population. However, in this thesis, only fifty-state panel data is shown. The aggregate national data regression model is also available in contact to the author.

(31) Simultaneous Equation Model is developed into Structural Equation Model, SEM. SEM was presented in 1960's in psychological research fields, but now prevailed in most social and natural science quantitative methodology. In this paper, pass analysis is used to show the relations between direct and indirect effects in OLS regression model, and pass analysis is part of SEM as well.

(32) In Printz v. U.S., Jay Printz and Richard Mack filed the case in which each of them claimed that Brady Handgun Violence Prevention Act is against the Constitution because the Federal Congress forces state officers to execute Federal law. Although lower courts held that the Brady Act is not unconstitutional, the Supreme Court ruled that although there is no unconstitutional text in the Act, historical provision and structure of the Constitution show the executive power was not granted.

(33) All the economic data are based on U.S. Bureau of Labor Statistics, U.S. Government Federal Reserve Board, and Department Commerce.

(34) In regression models, total effects are calculated by summing "direct effect" and "indirect effect." "Direct effect" is shown as a coefficient in regression model, but "indirect effects" are usually could not been handled due to its complicated interwoven relations with all the other variables. However, it is important to consider "indirect effect" since it contributes to "total effect," which is equivalent to correlation coefficients.

(35) R-squared is the ratio of the difference between mean value and estimated values to the difference between mean value and actual dependent values. In statistical models, R-squared show the fitness of the model, but still the model holds some significance even if R-squared is small. In this respect, the consistency of the effect in DID and FE/ME models are important to explain policy effect on the dependent variable.

(36) Bureau of Economic Analysis shows the state compensation for unemployment, so unemployment rates are gathered from various souses such as Department of Labor and others. Bureau of Economic Analysis: http://bea.gov/beahome.html. Department of Labor: http://www.dol.gov.

(37) Three estimators of Difference-in-Difference are calculated: CCW, Post-Brady, and NICS. Here is the example to calculate CCW in STATA.

```
gen     treatBrady = sid if ( ccw==1)
gen     afterBrady = year if (ccw==1)
gen     treatafterBrady = treatBrady*afterBrady
reg     gun  treatBrady  afterBrady  treatafterBrady
```

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```

(39) The concept of DID analysis is derived from how treatment and non-treatment groups are different from each other to a certain explained variable: in this thesis, that is gun-homicide ratio.

(40) The results of National data analysis is available on demand to the author.

(41) The term of "statistically significant" is derived from how much researchers consider probability of the relations among variables occurs. Some might proclaim if more than half it occurs, it should be considered "significant." Avoiding such individual researcher' s subjectivity, 95% significance is usually used, and in some strict cases 99% is used in statistical analyses.

(42) The number of "shall issue" states are increasing through 1999 to 2004, but the decreasing trend has stopped since 1999. This contribute to the main reason why "shall issue" laws positively affects the increase of gun-homicide rate.

(43) The significance of positive relations between gun-homicide rate and unemployment should be highly considered since the cost of gun-homicide rate requires remedy or compensation by society.

(44) National Rifle Association, NRA, have aggressively supported many kinds of small weapons into the public. One of them was bullets that could penetrate bullet-proof vest of police enforcement officers. The police officers stood against such weapons prevailed among citizens. Since 1980's, it is said that NRA and gun-lobby confront each other, and the police officers are favorable for gun-control activities such as Brady Campaign and Millions Mother March movement.

(45) Black and Nagin asked Lott and Mustard to analyze their data. Lott and Mustard generously offered their data to Black and Nagin. In quantitative researches, the results are sometimes reviewed by other researchers. In this sense, methodology is close to natural science researches, where new findings are always reviewed and followed by other researchers to confirm the findings are true or not.

(46) Webster pointed out that in 1980' s, drugs were immensely prevailed in large cities in the U.S. Thereafter, the police enforcement were strengthened to counter such urban criminals. Thus, "shall issue" effect should be counted more later if any Webster maintins (Webster et al. 1998).

(47) To research how indirect effects are interwoven, structural equation models are being developed now, especially in the field of psychology, pedagogy, sociology, and political sciences.

Supplement Data A: Waiting Period in Each State

The following states require some kind of safety training before a person can buy a handgun: California, Connecticut, Hawaii, Massachusetts and Michigan. Nov. 30, 1998, the background check is shifted to computerized National Instant Check System.

State	BC, Background Check (time of purchase) Federal=0 State=1	WP, Waiting Period	BC times WP
AL	0	0	0
AK	0	0	0
AZ	1	0	0
AR	0	0	0
CA	1	10	10
CO	1	0	0
CT	1	14	14
DE	0	0	0
FL	1	3	3
GA	1	0	0
HI	1	15	15
ID	0	0	0
IL	1	3	3
IN	1	0	0
IA	1	3	3
KS	0	0	0
KY	0	0	0
LA	0	0	0
ME	0	0	0
MD	1	7	7
MA	0	30	0
MI	1	1	1
MN	0	7	0
MS	0	0	0
MO	0	7	0
MT	0	0	0
NE	1	2	2
NV	1	0	0
NH	1	0	0
NJ	1	30	30
NM	0	0	0
NY	1	180	180
NC	1	30	30
ND	0	0	0
OH	0	0	0
OK	0	0	0

OR	1	0	0
PA	1	0	0
RI	0	7	0
SC	0	0	0
SD	0	0	0
TN	1	0	0
TX	0	0	0
UT	1	0	0
VT	1	0	0
VA	1	0	0
WA	1	5	5
WV	0	0	0
WI	1	2	2
WY	0	0	0

Data: Jan. 2003. Brady Campaign

Supplement Data B: The year of adaptation of CCW law by states

	Year of CCW Adoption				
Alabama	86	Kentucky	96	North Dakota	86
Alaska	94	Louisiana	96	Ohio	4
Arizona	94	Maine	86	Oklahoma	95
Arkansas	95	Maryland		Oregon	89
California		Massachusetts		Pennsylvania	*89
Colorado	3	Michigan	00	Rhode Island	
Connecticut	86	Minnesota	03	South Carolina	96
DC		Mississippi	95	South Dakota	86
Delaware		Missouri	90	Tennessee	94
Florida	87	Montana	3	Texas	95
Georgia	89	Nebraska		Utah	95
Hawaii		Nevada	95	Vermont	before86
Idaho	90	New Hampshire	86	Virginia	95
Illinois		New Jersey		Washington	86
Indiana	86	New Mexico	3	West Virginia	89
Iowa		New York		Wisconsin	
Kansas		North Carolina	95	Wyoming	94

*Philadelphia was excluded until 1995
Sources: Ayres and Donohue(2004) Lott and Mustard(1997) and others

Supplement Data C: Aggregate national average homicide rate by gun per 100,000

	homicide-by-gun ratio per 100,000
1976	5.543
1977	5.552
1978	5.728
1979	6.193
1980	6.405
1981	6.136
1982	5.490
1983	4.828
1984	4.667
1985	4.657
1986	5.049
1987	4.886
1988	5.109
1989	5.407
1990	6.038
1991	6.469
1992	6.334
1993	6.615
1994	6.271
1995	5.609
1996	5.008
1997	4.594
1998	4.056
1999	3.699
2000	3.606
2001	3.503
2002	3.748
2003	3.781
2004	3.611

Source: FBI Uniform Crime Report
U.S. Census Bureau Statistics

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